SUMMARY PROJECT PLAN
UNIVERSITY OF NORTH DAKOTA
ENERGY AND ENVIRONMENTAL RESEARCH CENTER
STACK SAMPLING

"MERCURY REACTIONS IN POWER PLANT PLUMES: PLANT BOWEN"

INTRODUCTION

Both natural and human processes emit mercury that cycles through atmospheric, aquatic, and terrestrial environments. Forms of mercury that appear most important in these environments are elemental mercury (Hg^0), inorganic or oxidized mercury (primarily Hg^{2+}), and methylmercury. The chemical form of mercury affects its transport through air, land, and water as well as its chemical and biological behavior.

Although in-stack mercury speciation measurements are essential to develop and test control technologies and to provide data for input into atmospheric deposition models, the determination of speciation in a cooling coal combustion plume is more relevant for use in estimating mercury fate and effects. Although substantial research has been done in the past on mercury transformations within energy conversion systems—determining the concentrations of speciated mercury at the stack and doing ground-level atmospheric measurements—little has been done to determine the mercury chemistry, kinetics, and thermodynamics in the flue gas plume. Therefore, a logical step in mercury research is to apply what we know to extend this understanding beyond the system to the plume region.

Therefore, EPRI has contracted with the Tennessee Valley Authority (TVA) and Frontier Geosciences to measure mercury in the plume emitted from a coal-fired boiler stack using aircraft equipment with mercury monitors and the Frontier Geosciences static plume dilution chamber (SPDC). In support of this work, the Energy & Environmental Research Center (EERC) will provide in-stack mercury measurements using the Ontario Hydro (OH) mercury speciation method and continuous mercury monitors (CMMs). The EERC will also work with Frontier Geosciences to ensure all necessary mercury analyses are completed. The proposed EERC work will be conducted in conjunction with an EPRI-, DOE-, and EPA-funded project to evaluate the effects of selective catalytic reduction (SCR) on mercury speciation.

TEST OBJECTIVES

The goal of the program is to collect the information and measurements necessary to evaluate the transformations and fate of speciated mercury emissions in a coal combustion plume. The goal of the EERC portion of this work is to provide speciated mercury emissions in-stack at the Bowen Station. Specific objectives are to:

- Quantify speciated mercury emissions at the stack for Units 1, 2 and 4 using the OH speciation method in conjunction with plume sampling
- Quantify speciated mercury emissions at the stack for Units 1, 2, and 4 using a CMMs for the duration of the project.

- Collect and analyze daily coal and ash samples for mercury as well as other constituents that may play a role in mercury speciation.

UNITS TO BE TESTED

The four units at the Bowen Station are arranged such that units 1 and 2 share a stack superstructure, as do units 3 and 4. Because of this, it is impossible to separate the emissions. Therefore is essential to measure the mercury species from each of the stacks. Based on discussion with plant personnel, during the testing period (October 7 to October 21, 2002), Unit 3 will not be operating and the SCR will be bypassed on Unit 1. However, the SCR will be operating on Unit 2. The configurations of the three units to be sampled are shown below:

Fuel type:	Eastern bituminous coal (all units)
Boiler type:	Tangentially fired with pulverized coal (all units)
Boiler capacity:	Units 1 and 2 are 800 MW
	Unit 3 is 952 MW
Particulate control:	Cold-side ESP (all units)
NO_x control:	Units 1 and 2 – SCR (SCR will be operated on Unit 2 only)
	Unit 4 low-NO_x burners and overfire air
SO_2 control:	Compliance coal (all units)

EERC TESTING SCHEDULE

The testing schedule includes 14 days in which to complete 5 days of plume sampling. The test period will run from October 7 through October 21, 2002. The in-stack emissions sampling on Units 1, 2, and 4 will be completed together in conjunction with the plume sampling that will be done by TVA and Frontier Geosciences. Tables 1, 2 and 3 outline the sampling matrix. As can be seen in Table 1, EERC personnel will arrive at the Bowen site on September 18, 2002 to begin the SCR/mercury project. As part of this project, CMMs will be set up and operated at Units 1 and 2. These CMMs will remain in operation until the completion of the plume study.

Table 1. CMM Operation Schedule at Bowen[1]

Operation	Location	Date Begin	Date End
CMM Setup	Stack at Unit 1 and 2	09-18-02	09-20-02
CMM Setup	Stack at Unit 4	10-05-02	10-07-02
CMM Operation	Stack at Unit 1 and 2	09-20-02	10-21-02
CMM Operation	Stack at Unit 4	10-07-02	10-21-02
CMM Tear Down	NA	10-22-02	10-22-02

[1]Units 1 and 2 will be tested as part of the SCR/mercury project that will also be conducted at the Bowen station.

One OH sample will be taken simultaneously at each of the three stack locations for each flight day. This results in a total of 5 samples taken at each location. A lower flow rate (and smaller nozzle) will be used so that a 3-hr integrated sample can be obtained.

Table 2. OH Flue Gas Sampling Schedule at Bowen

Location	OH Method	Date Begin	Date End
Stack Unit 1	5	10-07-02	10-21-02
Stack Unit 2	5	10-07-02	10-21-02
Stack Unit 4	5	10-07-02	10-21-02
Teardown		10-22-02	10-22-02

Table 3. Coal and Fly Ash Sampling and Analysis Matrix at Bowen

Material	No. Samples	Chloride	Mercury	Ult./Prox.	XRF[1]	LOI[2]
Coal	1 composite/day	X	X	X	X	
ESP Hopper Ash	1 composite/day		X		X	X
Filter Ash from OH method	Each OH method		X			

[1] X-ray fluorescence analysis for major elements as well as some trace elements (select three at random)
[2] Loss on ignition (select six at random).

PROJECT COORDINATION

A total of 14 days are being allotted to obtain 5 days of testing. The testing days will be determined by weather patterns that will be communicated to the airplane personnel by the weather stations. It is expected that the daily sampling window will be between 10:00 and 16:00 each day. The decision to fly will be tentatively made by midnight of the night before. The final decision will then be made by 8:00 the next day. The decision will then be communicated to project participants through a morning meeting as well as by telephone. In addition, each night a meeting will be held to communicate any issues that arise during testing.

PLANT PARTICIPATION

For successful project initiation, Bowen plant personnel will need to provide assistance to the EERC as outlined below:

- Unit access: appropriate access to ports at each location (verify ports are clean). As required by the plant, a site access agreement will be in place.
- Utilities
  - Space for two sampling trailers for the duration of sampling, plus vehicle parking
  - Electricity: At each of the stack location four 20-amp circuits and one 30-amp circuit for each trailer.
- Desired Plant data. Data will be needed for the period of September 18 through October 22, 2002. It is expected that the data will be provided to the EERC electronically on an hourly basis.
  - Load
  - Coal feed rate
  - CO
  - CO_2
  - NO_x
  - SO_2

- O_2
- Opacity
- ESP temperatures
- Gas flow rates

• Safety training/explanations
• A plant contact person
• Access to the internet for downloading data

PROJECT PERSONNEL

Table 4 shows the test program's key project personnel for the EERC with their roles, phone numbers, and email addresses.

Table 4. Project Management

Person and Project Role	*Contact Information*	*Reports to*
Larry Monroe Southern Company Key Company Contact	Phone (205) 257-7772 lsmonroe@southernco.com	–
Bill Aljoe, DOE Project Advisor	Phone (412) 386–6569 William.aljoe@netl.doe.gov	–
Leonard Levin, EPRI Project Advisor	Phone (650) 855-7929 llevin@epri.com	–
Dennis Laudal, EERC Project Manager	Phone (701) 777–5138 dlaudal@undeerc.org	Project Advisors
Chad Wocken, EERC Principal Investigator	Phone (701) 777–5273 jthompson@undeerc.org	Dennis Laudal, EERC
Richard Schulz, EERC Field Manager	Phone (701) 777–5218 Cell (218) 779-2454 rschulz@undeerc.org	Dennis Laudal, EERC

QA/QC, SAMPLING PROTOCOL, AND INSTRUMENTATION

Detailed information covering QA/QC, sampling protocol, instrumentation, and other technical data is available upon request.

REPORTING

At the completion of the project approximately 6 weeks will be necessary to complete all the analysis and do the necessary data reduction. The draft report is expected to be completed by the end of December 2002. However, during this time, the results may be communicated to the team members as required by the EPRI project manager so that other team member's reports can also be completed